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IP MESH Radio System Manual

NETNode User Manual

V1.2 24th September 2009

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Change History

Version	Main Changes from Previous Version	Edited By
v1.0	Initial Release	NMcS
v1.1	Alterations	CB
V1.2	Customer release	NMcS



About this Manual

This manual describes the operation of **domo** IP radio MESH systems. The manual is divided into three main sections.

- **Getting started and basic operation**

This section describes to users how to deploy and use a **domo** IP Radio MESH system with its associated NETNode units in typical operational scenarios.

- **Advanced operation**

This section describes the operation of the system in more detail, concentrating particularly on secondary functions such as importing mapping information and working with configurations.

- **Technical reference**

This section provides technical specification and control protocol data and will be of interest to those integrating the MESH system into larger systems.

Introduction

Cobham Surveillance **domo** has been supplying point to point high data rate digital video links for many years to security users. These links exhibit exceptional performance, enabling users to reliably exchange video data in extreme RF environments such as mobile and urban. More recently **domo** has seen an increasing requirement to use the rugged transmission capabilities of COFDM to carry general purpose IP traffic.

There is now also increasing demand from **domo** customers to incorporate bi-directional capability in its solution, and also a MESH capability.

The traditional two frequency approach (Frequency Division Duplex or FDD) to enable bi-directionality is not convenient or appropriate in many applications; the use of separate frequencies makes frequency management difficult. Also FDD adds complexity, cost and weight with additional antennas, amps and circuitry.

The solution to this problem is a single frequency approach (Time Division Duplex or TDD) where all communicating nodes share the same frequency. This simplifies frequency management and circuitry implementation.

MESH Applications

- Mini and Micro UAV communications
- Radios to connect surveillance team vehicles
- Special Forces data radios.
- Military vehicle radios.
- True real time surveillance / pursuit where an ad-hoc network is used relay imagery in a fluid environment. This would apply equally to manned surveillance as to vehicle pursuit.
- Next generation Unmanned Ground Vehicles (UGVs) where vehicles operate co-operatively.
- FIST battlefield communication applications.
- Perimeter security applications.

Each MESH NETNode has two Ethernet interfaces to allow flexibility of connection. This in conjunction with the radio link provides the same functionality as a switched Ethernet hub.

The radio technology is based on the fundamentals of the acclaimed **domo** Solo4 rugged, robust and reliable transmission system giving an extremely secure and easily deployable bi-directional communication system.

AES BCRYPT1 encryption/decryption (AES128 & 256) is also supported on both forward and reverse paths of the MESH system. AES support is an optional software feature and may require an export license.

domo MESH Features

- Single frequency IP MESH Network
 - Reduces antennas, amplifiers, filters in a bi-directional unit
- No central Node (genuine Mesh)
 - No single point of failure
 - Makes a very adaptable
- Rapid connection and disconnection
 - Nodes are able to connect into the network within 2 seconds without user intervention
- 8 Nodes Maximum
 - 8 nodes provides a good balance between capacity and latency
- Very rugged RF link
 - Proven to be 5 to 10 times better than Wi-Fi per link

IMPORTANT NOTE

The MESH IP Radio product range has been specifically designed for government security and law enforcement users, the equipment will tune across frequencies that are only available to licensed government users. Non-government users should employ the equipment restricted to the license exempt bands only typically 1.389 to 1.399GHz, 2.400 to 2.483GHz and 5.725 to 5.875GHz

Warranty and Support

Warranty Cover

domo offers a 12 month standard product warranty. During this period, should the customer encounter a fault with the equipment we recommend the following course of action:

- Check the support section of the website for information on that product and any software/firmware upgrades. If fault persists;
- Call our support line and report the fault. If fault persists and you are informed to return the product please obtain an RMA number from the **domo** support department, and ship the equipment with the RMA number displayed and a description of the fault. Please email the support section the airway bill/consignment number for tracking purposes.
- If you have extended warranty provisions then **domo** will send an immediate advance replacement to you. Under most circumstances this must be returned once the fault item is repaired.

Depending on the nature of the fault **domo** endeavour to repair the equipment and return it to the customer within 14 days of the item arriving at our workshops. Obviously it is impossible to cater for all types of faults and to manage 100% replacement part availability, and delays are sometimes inevitable. This is why **domo** recommend that its customers take out an extended warranty (which includes advanced replacement of faulty items), and/or hold a basic level of spare parts, which can be held by **domo** on the customer's behalf.

Please contact **domo** for details of packages that can be tailored to meet your individual needs, whether they are service availability, technical training, local geographic support or dedicated spares holdings.

Safety, Compliance and Approvals

Safe Operating Procedures

- Ensure that the power supply arrangements are adequate to meet the stated requirements of each MESH NETNode enclosure.
- Operate within the environmental limits specified for the product.
- Do not subject the indoor equipment to splashing or dripping liquids.
- Only authorized, trained personnel should open the product. There are no functions that required the User to gain access to the interior of the product.

EMC / Safety and Radio Approvals

The equipment has been designed to meet and has been tested against the following harmonized EMC and safety standards:

- EN 301 489-1 & EN 301 489-5
- EN 61000-3-2:2000
- EN 61000-3-3:1995
- EN 55022:1998, Class B
- EN 61000-4-2:1995
- EN 61000-4-3:1996
- EN 61000-4-4:1995
- EN 61000-4-5:1995
- EN 61000-4-6:1996
- EN 61000-4-11:1994
- EN 60950:2000

CE marking

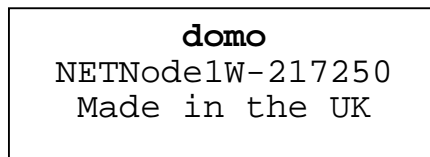
The CE mark is affixed to all SOLO4 and SOLO2 products, and the CE Declaration of Conformity, as well as the technical file is available on request.

Getting Started and Basic Operation

Which Model do I have?

Each unit in the **domo** product range is marked with two panels.

- Product Code Panel. Give product code and manufacturers information.
- CE and Serial Number Panel. Gives CE mark and product serial number.



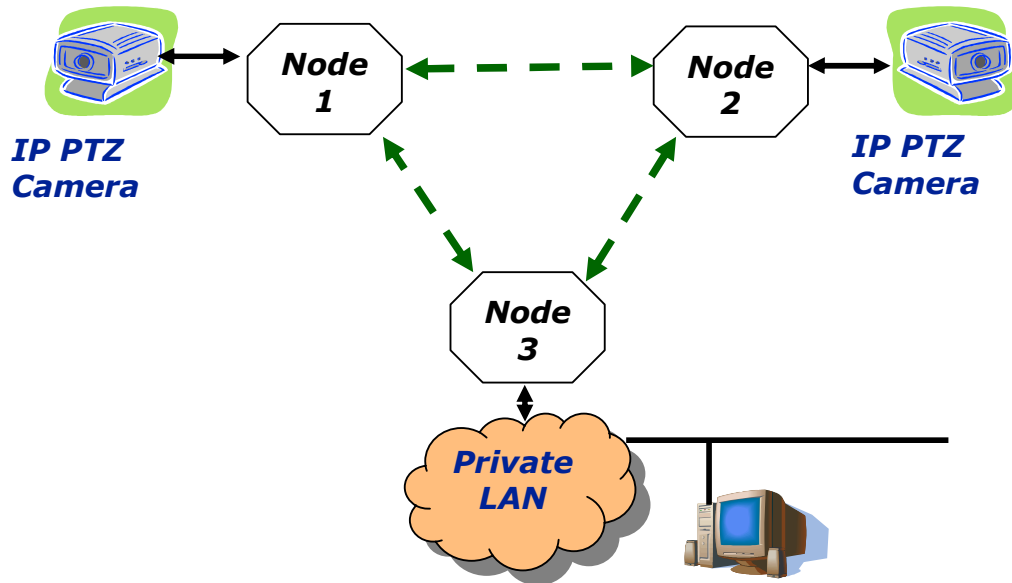
The **domo** product code can be referenced in the table below.

Product Code	Product	Accompanying items
NETNode1W-217250 (2.17 to 2.50GHz)	1W RF output MESH link (1 node)	Cables: 1-off Control 2m (CA288) 1-off DC Power 5m (CA285) 1-off Ethernet 5m (CA284) CD with operating software and manual
NETNode1W-550600 (5.5 to 6.0GHz)	1W RF output MESH link (1 node)	Cables: 1-off Control 2m (CA288) 1-off DC Power 5m (CA285) 1-off Ethernet 5m (CA284) CD with operating software and manual
NETNode-AVI-UP	Audio/Video Input option Fitted inside the NETNode	Cables: 1-off A/V cable 2m (CA286)

Note that Antennas are not included with this product.

Basic Operating principles

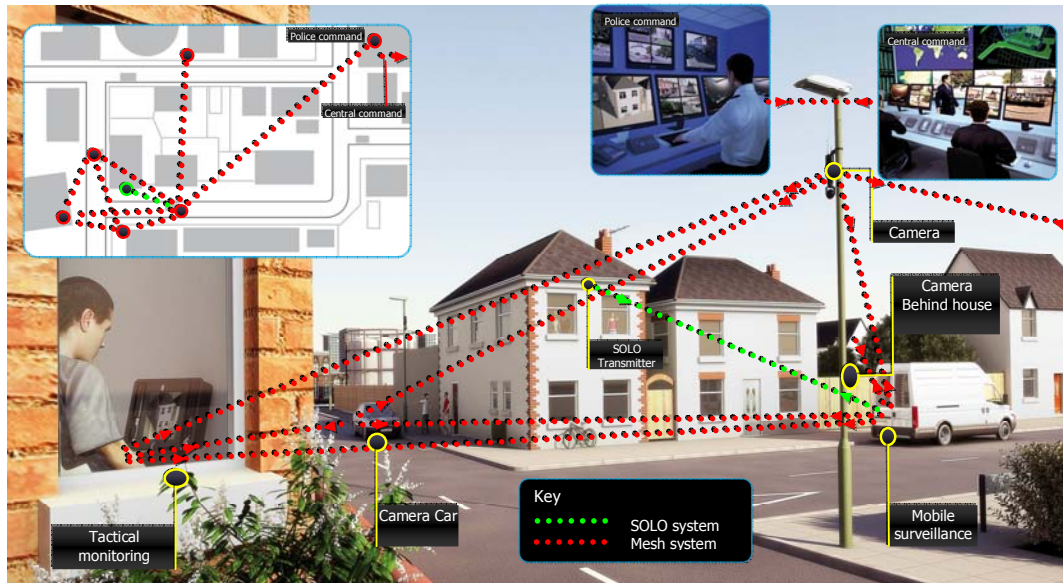
As an example a system is shown with two IP cameras contributing into a Private LAN using the MESH system. Each MESH NETNode behaves as a switched hub providing two physical Ethernet ports, and a connection onto the mesh radio link.



All NETNode units are connected to each other as a wireless IP network. The Mesh system arbitrates which node transmits at any given time avoiding any conflict.

The nodes are able to seamlessly connect into the network without user intervention. The only key parameters that need to be preloaded into the units are the encryption keys and the frequency.

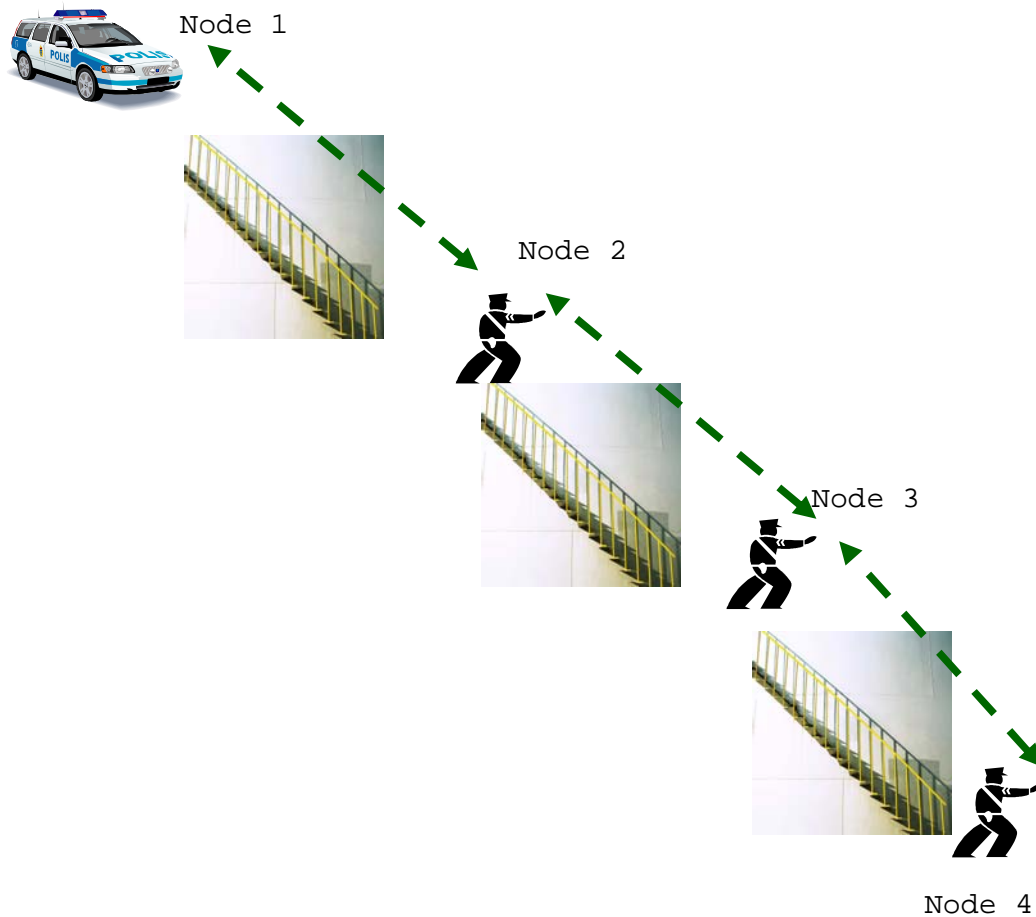
Mesh could also be used to quickly deploy a multiple node surveillance system around an area of interest. The NETNode units could be used to contribute Video or IP data such as stills photography or sensor data.



The NETNode can accept video from a standard composite (PAL/NTSC) camera or an IP camera can be connected through the MESH Network. To connect a standard composite video signal into a MESH NETNode the DUO-AVI option must be fitted into the NETNode.

The MESH is not able to support 4 full quality video links through the one frequency – if 3 nodes were to contribute video simultaneously then the bit-rate for each link would have to be adjusted to roughly 700kbps per video service. Full frame rate video can be supported at 700kbps but at reduced resolution – typically $\frac{1}{2}$ resolution would be selected. Higher resolutions could also be supported – even up to full resolution but typically not at full frame rate.

The MESH can also be used to facilitate range extension. Nodes can communicate through a chain.



In this example the MESH system is used to provide a video link back through a chain to a command vehicle. Using VOIP all the operatives could also be listening and communicating over the network.

Getting started on the bench

Cables and Connections

This section describes how to connect the following **domo** model numbers.

- NETNodeIP1W-217250 (2.17 to 2.50GHz)
- NETNode-AVI-UP (option)

The pictures below show the Phase1 **domo** NETNode product.



A **domo** MESH NETNode is supplied with the following cables:

- IP via Ethernet x 1
- Control 2m x1
- DC Power 5m x1
- AV 2m x1 (if the DUO-AVI option is ordered)

Before deploying **domo** MESH NETNode units in the field it is strongly advised to test the products in a bench environment in order to gain familiarity with the product.

BEFORE SWITCHING ON THE UNIT PLEASE NOTE:

The DC power supply must be set to 12.5V and assume up to 2.5A of current draw.

Procedure for Establishing Connection to a Node

Once a user has connected to a unit and established a NETNode on their network operating the system is easy.

The procedure to establish communication with a node varies depending on whether the User wishes to connect the MESH to a network running DHCP or whether the user wishes to run with static IP addresses.

The user must start by testing one MESH node at a time connected to the Users Network. This example assumes that the User network supports DHCP. Connect a Windows PC to the DUO CTRL/DATA port using the CTRL/DATA cable (CA288). Run the MESH PC Control application. This application will identify the IP address of any mesh nodes on the Network. Tick the Ethernet Radio box and read the IP addresses.

If the User's Network does not support DHCP then a PC running the MESH PC control application must be connected using the CA288 cable to connect from the RS232 port on the PC to the Control port on the MESH node. The RS232 control 9-way D-type must be used.

The screenshot shows the 'Forward unit' configuration window. Annotations include:

- An arrow pointing to the 'Connected unit' section with the text: "Select Ethernet or RS232".
- An arrow pointing to the 'IP address' field with the text: "IP address of any unit on the Network".
- An arrow pointing to the 'Global settings' tab with the text: "Select the 'Global Settings' tab.".
- An arrow pointing to the 'Apply' button with the text: "Apply".

Other visible elements in the window include:

- Buttons: File, Options, Connect, Global settings, Config settings, Save config, Load config, Refresh tab, Refresh all, Apply.
- Fields: Unit type (141), MAC address (00-11-6A-F1-A9-B0), Software version (b1.3), FPGA version (1), Board type (14), Serial number (ABBA9BC6), Control/data port select (RS232/RS485), Auxiliary address (0001), Subnet address (192 . 168 . 2 . 220), Subnet mask (255 . 255 . 255 . 0), Gateway (0 . 0 . 0 . 0).
- Status indicators: Transmitter on, Demod lock status, Bidirectional link status, Connection status.
- Text: "Polling enabled", "Connected".

If the NETNode unit is connected to a network that supports DHCP then leave the DHCP option box checked. If the network does not support DHCP then a valid static IP address must be entered and the DHCP box unchecked.

Click 'Apply' after changing any configuration setting

Once the IP address is established the web-server should be used to configure frequency and output power. Once the node is on the User network any Web-browser can be used to browse to the Mesh NETNode to configure and control the node or to browse network status. The unit can be browsed by entering the relevant IP address in the web-browser.

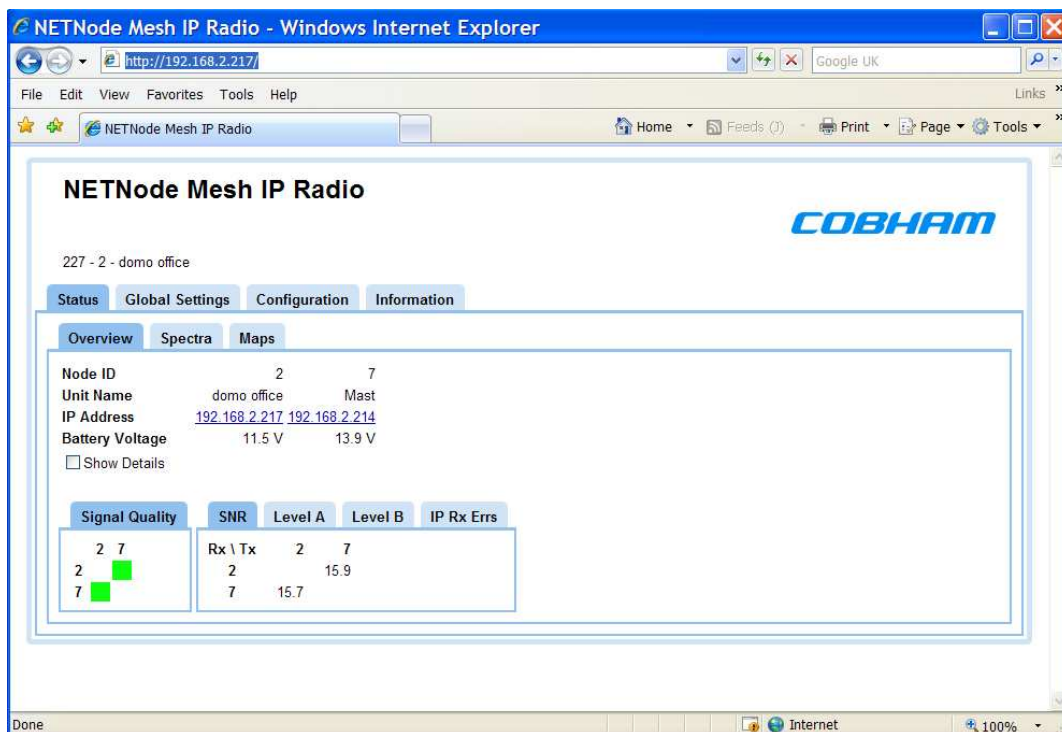
Web-browser Username and Password

The web-browser will prompt for a Username and Password on the first connection.

Username should be left blank

Password is 'meshweb'

The status page will be displayed upon successfully entering the Username and Password.



Navigate to the Configuration page by clicking the Configuration Tab.

Fit the two antennas onto the two TNC connectors.

Set **Output level select** to 'Low' and set **Enable** 'ON' by 'ticking' the check box.

Click 'Apply' after changing any configuration setting

Check that the Frequency is valid for the operation of the unit – specific country regulations will determine the frequencies available for operation. Note that 2400 to 2480MHz is licence exempt in most of the world.

For the units to function in a single network the following must be set correctly:

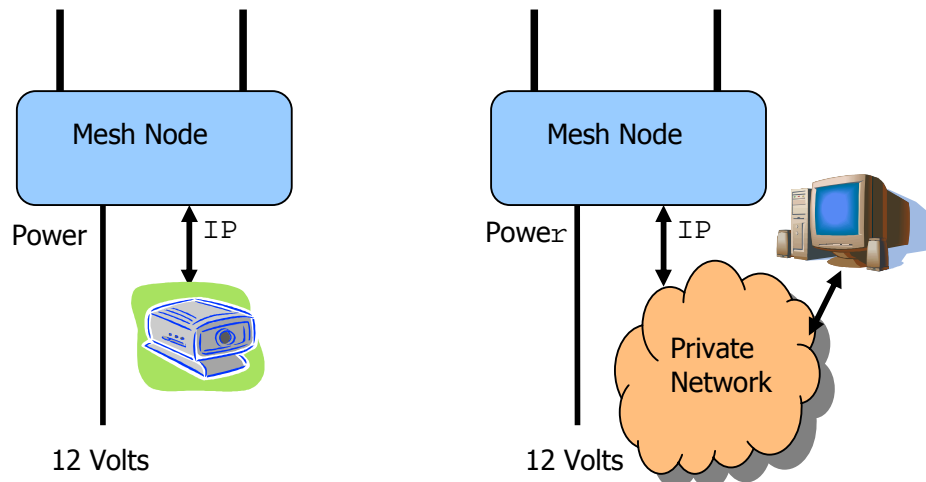
- 1) All units are on the same frequency
- 2) All units have the same channel bandwidth set
- 3) All units have their Transmit enabled

- 4) All units must have the same mesh ID
- 5) Each unit must be assigned a different node ID (0-7).
This is most important for the network to function correctly.
- 6) If encryption is enabled then the encryption type and keys must match.

Power down the unit.

Repeat the procedure for a second node – making sure that the frequency is always set to be identical.

Domo suggests configuring the system on the bench as outlined below.



BEFORE SWITCHING ON THE WHOLE SYSTEM PLEASE NOTE:

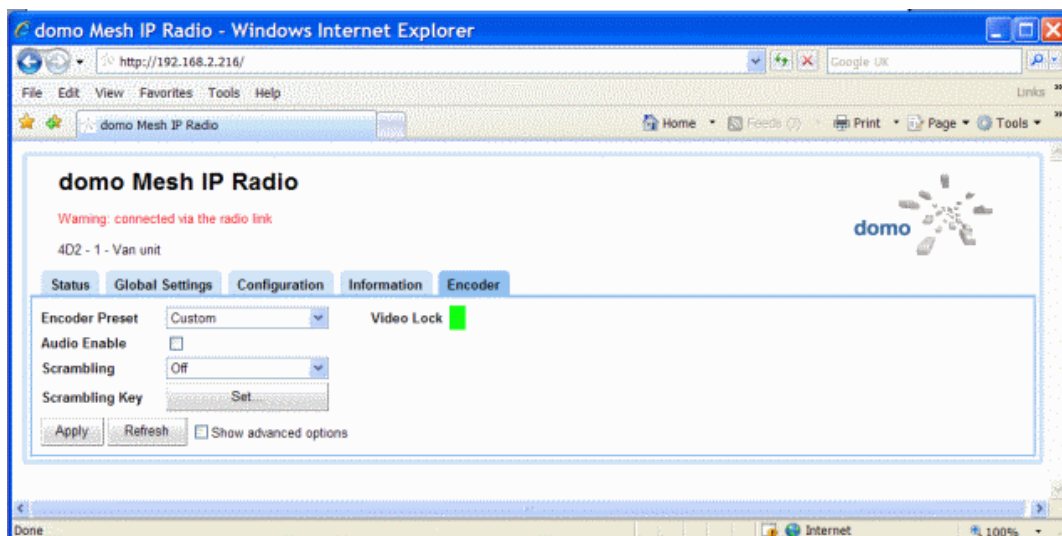
The DC power must be set to 12.5V and assume up to 2.5A current draw.

Don't connect the Ethernet ports of both units simultaneously to your network when they are both operating as you will create a loop in and out of your IP network. This may affect your network performance.

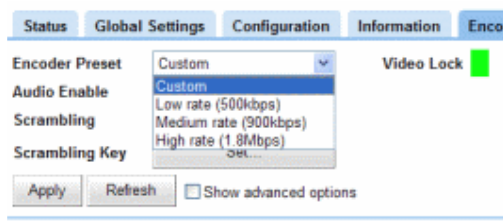
Connect one MESH node unit to your network and the other MESH node to an IP camera or a standalone PC. The IP Camera or the standalone PC will then be connected to your network through the MESH network.

Integrated Video Encoding AVI option fitted (Composite Input)

The user must enable the video transmission. If the MESH node has an AVI option fitted then it will accept standard composite video (NTSC or PAL) and it will encode and stream the video over the Network. An Encoder Tab appears on the Web-browser if an internal video encoder is fitted.



The user can select from a number of preset Encoder options



Using the advanced options the user can more precisely customise the encoder settings.

Click 'Apply' after changing any configuration setting

DC Power

The NETNode can be powered from a nominal 12V DC supply or an AC to DC adapted supply.

Locate, push and twist to lock the Amphenol connector on the Power cable into the socket labelled POWER, taking care to align the connectors. Connect the banana connectors on the other end of the cable to a suitable DC source.

The 12V DC input has the following characteristics.

- Input Voltage Range – 12V to 15V, **not** reverse voltage protected (1W unit).
- Current draw – 1.2A to 2A at 12V (capacity dependant)

Ethernet

Locate, push and twist to lock the Amphenol connector into the socket labelled 'IP', taking care to align the connectors.

Video and Audio Input (if Option is present)

Locate, push and twist to lock the Amphenol connector into the socket labelled 'AV', taking care to align the connectors. Connect the video and audio sources.

Connector	Signal
Video BNC	75 ohm composite video source, PAL or NTSC software selectable
Audio Plugs	Line / Microphone level audio, switchable. Line level -2dBu clip level low impedance source (< 600 ohm) Microphone level 12, 24, 36 and 48dB preamp stages software switchable

Microphone power is provided on the audio connectors at approximately 3V (suitable for Electret microphones)

Typically the video source should be a small colour or black and white CCD camera.
Typically the audio source should be an Electret microphone.

Antennas

It is important only to power up the NETNode unit with the Antennas fitted.

Both antennas must be connected for normal operation. The units are supplied with a panel mounted TNC connector which carries the RF input and output. The antenna should be connected by screwing it onto the TNC, but care should be taken to not over tighten the connector.

The units have the following RF output characteristics.

RF Spec	Model Number ending 217250	Model Number ending 550600
Output Frequency	2.170 to 2.50GHz	5.6 to 5.9GHz
Output Bandwidth	2.5/3/3.5MHz	2.5/3/3.5MHz
Output Power	1W or 100mW (nominal)	1W or 100mW (nominal)
Output Impedance	50 ohm	50 ohm

Note. It is recommended that the antennas be connected directly to the transmitter unit. The use of RF cables at this point will degrade the performance of the system.

The optimum choice of antenna will vary according to application. The following table gives some suggestions for suitable transmit antennas with the associated **domo** part number.

Application	Antenna model number
Mobile body worn application	1.00 to 1.40GHz - ANTBCL 2.28 to 2.50GHz - ANTBCS
Mobile vehicle application	1.00 to 1.40GHz – ANT4L 2.20 to 2.50GHz - ANT4S 5.60 to 5.90GHz – ANT4-560590
Long range point to point link	1.00 to 1.40GHz – ANT12L 2.28 to 2.50GHz – ANT12S 5.60 to 5.90GHz – ANT14-560590

Other antennas for more specialist applications, such as aircraft use or covert surveillance use are available on request from **domo**.

Deploying the system

All external connection to the MESH products should be made, as described in the previous sections, before proceeding to power on the system.

Installation Notes

This section gives guidelines for how to install the MESH node in the following applications.

Fixed position Applications

The MESH NETNode unit is designed to be waterproof allowing it to be installed outdoors.

Vehicle Applications

Interconnection between the unit and any antenna should be kept as short as possible, but where this is not possible, special attention should be taken to use only low loss cables. An appropriate cable might be RG213C/U. It is essential to minimise the distance between the unit and the antenna. Mounting holes are provided.

Power conversion will be required for 24V vehicles.

The video input can be connected across long video cable lengths so remotely mounted cameras should pose no problem.

The unit is self-cooling; however it should be mounted in a ventilated environment. Forced air cooling is not required.

Diversity and Antenna Positioning

The **domo** MESH NETNode product uses an advanced diversity technique called maximum ratio combining to construct a good spectrum from two potentially damaged received signals. This requires a small separation of the antennas.

Sometimes better results can be achieved by separating the antennas further, or by positioning them of different corners of a building. The optimum antenna placement depends on the environment in which the equipment is used and the signal path, and is often limited by physical factors (accessibility for example).

Any cable run between the Node and the antenna **MUST** be **LOW LOSS** cable.

Contact **domo** for details of suitable cable.

Battery / DC power considerations

The 1W output power MESH Node units can consume over 2amps of current at 12V.

They are designed to trip off at 10.5V and reset on at 11.5V. The DC cable supplied as standard with the MESH node is 5m long to allow a customer to mount the Duo on a mast. This suffers about 0.5V drop through the cable.

Therefore 1W MESH nodes need to be connected to a large capacity battery which is nominally 12V or to a 12V power supply. AC to 12V power supplies are not supplied as standard with the product.

Users can order a suitable universal AC to 12V power supply from domo as a cost option.

Product code	SOL4CLC-PSU
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NETNode specification

Interfaces	Antenna 1	TNC
	Antenna 2	TNC
RF	Ethernet I/O	4-way Amphenol socket Size 08
	RS485 / RS232	19-way Amphenol socket Size 14
	Power	2-way Amphenol socket Size 10
	Frequency Bands	2170 to 2500MHz
Modulation	Power	1W (100mW optional)
	Power Control	30dB
	Tuning Steps	125kHz
	Bandwidth	2.5 or 3 or 3.5 MHz (selectable)
Ethernet	FEC	1/2
	Modulation Forward Link	QPSK/16QAM Adaptive
	Sensitivity	-92 to -99dBm (mode)
	Physical	100 BaseT
	Data Rate	Network Toplogy dependent (Up to 2.5Mbps capacity in a 2.5MHz system. Up to 3.5Mbps capacity in a 3.5MHz system.)
		Internal packet compression will increase the data rate capacity for some types of packet considerably.
	Protocols	ARP, UDP control, Ping, TFTP upgrade IP and ICMP protocols between the radios MPEG over IP Encapsulation (UDP multicast + SAP)
	Delay	TBD

Video In (option)	Line Standard	PAL/NTSC
	Resolution	704, 528, 480, 352
	Coding Mode	MPEG2 or MPEG4
	Delay	60ms to 0.5 sec depending on mode
Audio In (option)	Frame Rate	Full / Half / Quarter / Eighth (optional)
	Input	Line Level or Microphone
	Sample Rate	32KHz, 16KHz, 8KHz switchable
Data Interface	Bits per Sample	12 or 8bit switchable
	RS485 Data I/O	1K2 to 115K6 baud switchable
Encryption	Format	AES128 / 256 Selectable (optional)
Control	RS232 Local Control	9K6 Control Port
	Remote Control Ethernet	Ethernet control with comprehens diagnostic capability
Physical	Dimension	L 260mm. W 194mm. H 57mm
	Weight	1Kg
Power	D.C input	11 to 14V only (No reverse power protection)
	Power Consumption	14W to 24W (Unit and mode dependant)
Environment	Temperature Range	-20 to +50 deg C
	Case	Waterproof robust enclosure



Web-server Control

MESH node units include support for web browser control. Web browser control provides the ability to control all the nodes in the network from a single browser connection to one of the Nodes. This reduces the possibility of a user mistakenly configuring the far end of a link and then losing control of the far end unit. The web server also provides access to a wealth of status information.

The IP address for the unit can be discovered via the Windows application using the IP address search facility or the RS232 interface.

The screenshot shows the 'Forward unit' application window. It has a menu bar with 'File' and 'Options', and a toolbar with icons for file operations. The main area is divided into several sections:

- Connected unit:** Includes radio buttons for 'RS232' and 'Ethernet'. The 'Ethernet' option is selected. Below it, there's a dropdown for 'IP address' with 'Manual' selected. A text box next to it shows '192.168.2.220'. A list box below the dropdown shows '192.168.2.122 [ESN 0x45A85B]' and 'Manual'. A line points from this list box to the 'IP Address' label at the bottom right of the image.
- Global settings / Config settings:** Two buttons to toggle between settings.
- Unit information:** A list of fields including Unit type (141), MAC address (00-11-6A-F1-A9-B0), Software version (b1.3), FPGA version (1), Board type (14), Serial number (ABBA9BC6), Control/data port select (RS232/RS485), and Auxiliary address (0001).
- Remote control lock:** A checkbox that is currently unchecked.
- DHCP enable:** A checkbox that is currently unchecked.
- Subnet information:** Fields for Subnet address (192.168.2.220), Subnet mask (255.255.255.0), and Gateway (0.0.0.0).
- Status indicators:** Four green circles on the right side, each with a label: 'Transmitter on', 'Demod lock status', 'Bidirectional link status', and 'Connection status'.
- Buttons:** At the bottom, there are buttons for 'Save config', 'Load config', 'Refresh tab', 'Refresh all', and 'Apply'.

IP Address

The IP address is listed under the Global Settings page on the Windows controller application.

It is possible to disable web access completely or to only enable the Web browser to view the configuration and status information but not to change the unit parameters.

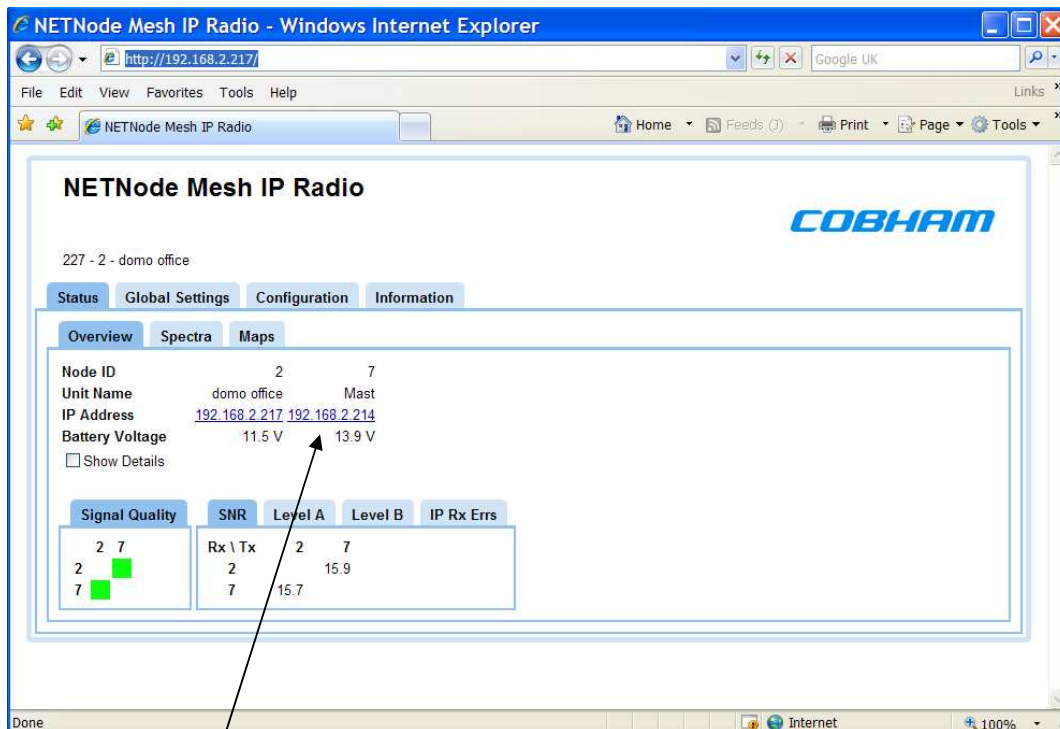
Password

The Web server is password protected. Before a user is able to view the web server the user must first enter a valid password. The user name is not required. The default password is 'meshweb'.



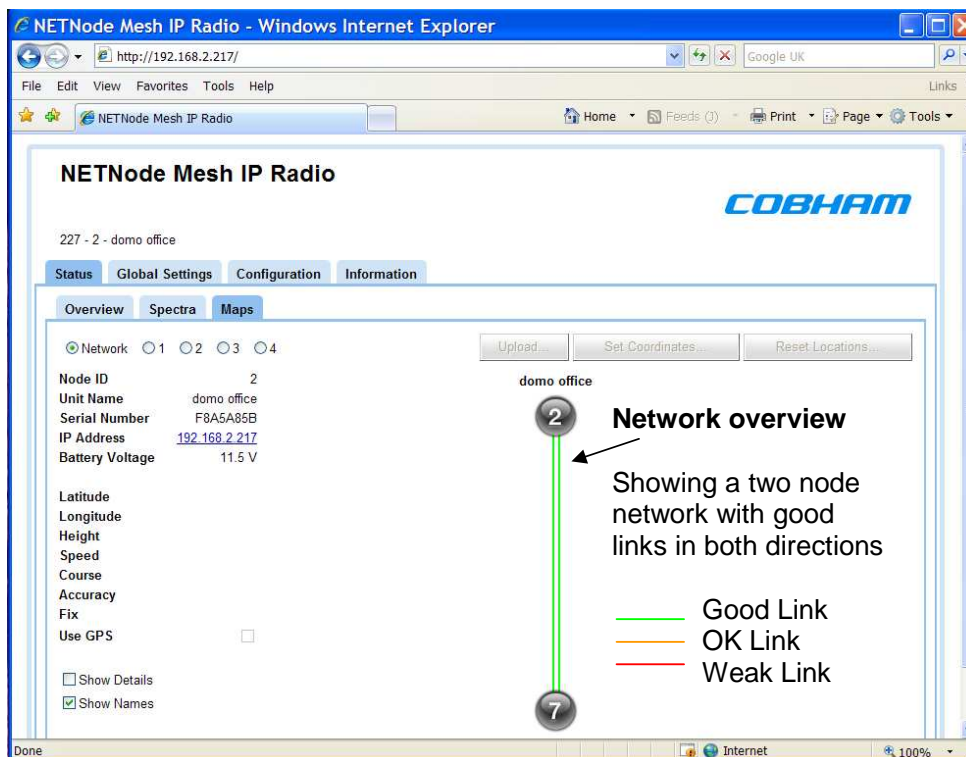
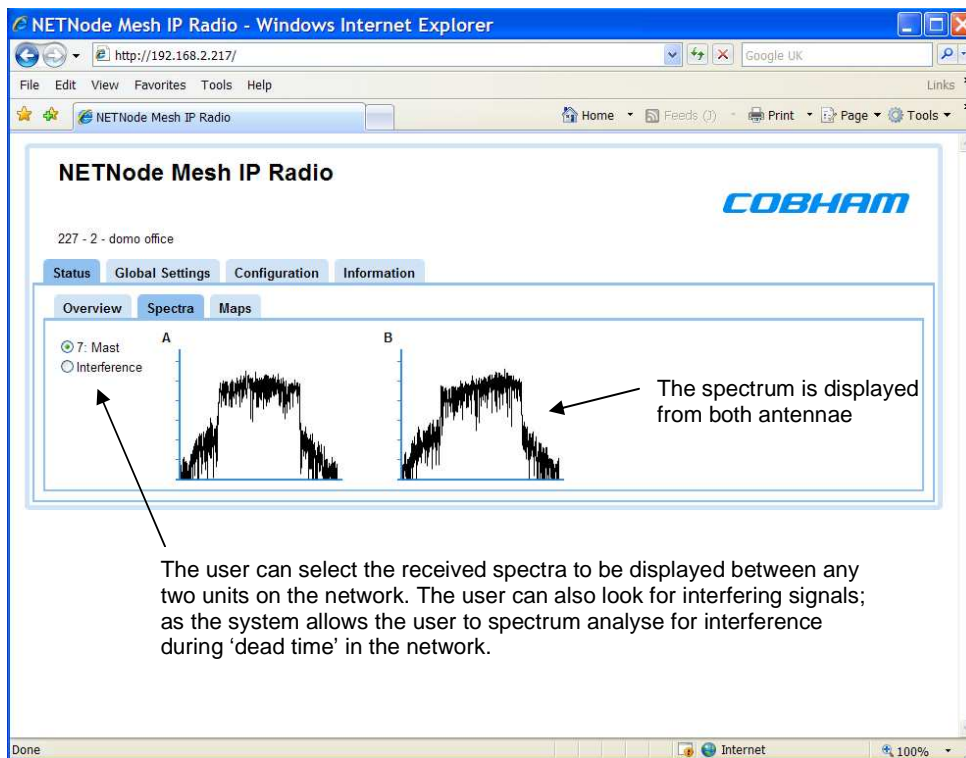
The front page splits the available information into Tabs. When the password is entered successfully the Browser displays the top level Status page.

Status Page

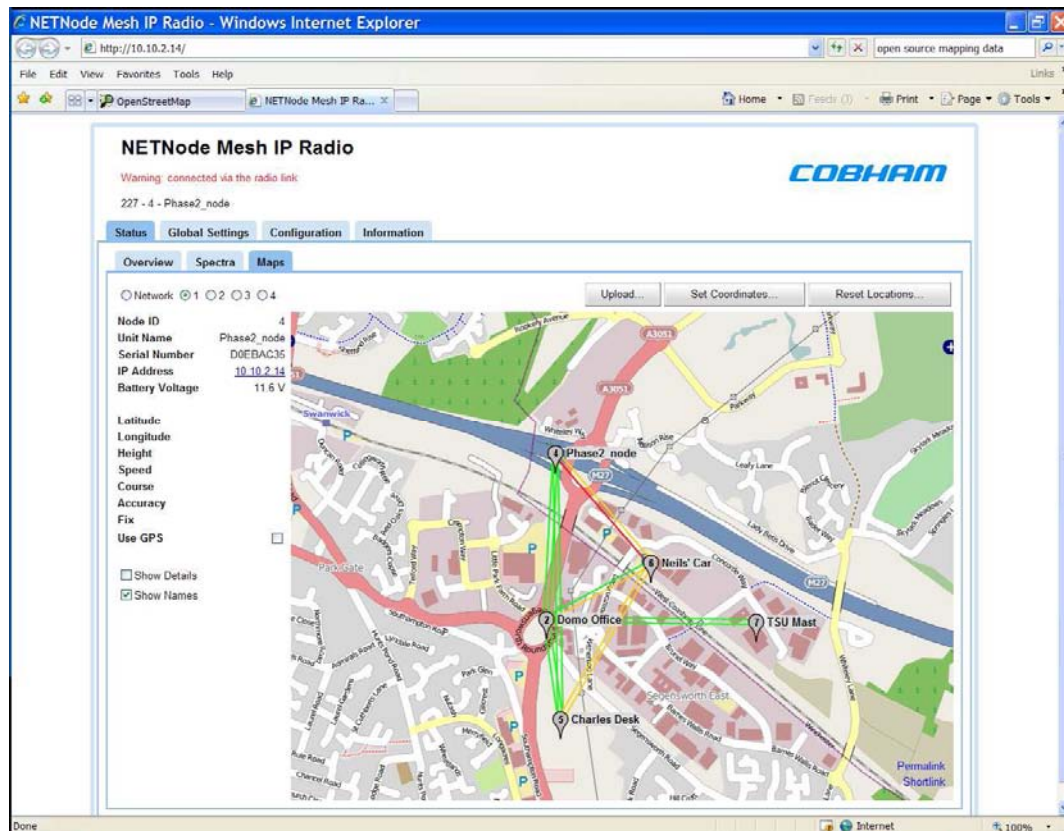


The hyperlinks will take you to any other MESH NETNode units that are present in the MESH IP Radio wireless network.

The Status Page has two additional 'Tabs'; the 'Spectra' tab allows the user to look at received spectrums from any other Nodes and the 'Maps' tab allows users to view a conceptual top level map of all the nodes in the network with the quality of their interconnections. The 'Maps' tab also allows users to upload up to 4 of their own geographical maps – these can be linked to GPS data so that the position of any GPS enabled NETNode units can be actively tracked live on the Map image.



Status Map 'Tab'



Mapping data taken from OpenStreetMap

Uploading a Map

1. Check the internal drive is formatted. This can be accomplished by entering the Information page (click on the Information Tab) click the file system button and check if it is formatted. If it is not formatted click onto Global Settings tab and click format file system – internal or external and wait until the file system is formatted. This can take up to 1 minute to format. The node name on the top banner of the browser page changes to show that the formatting is under way and reverts back to normal when the process is completed.
2. Click the Upload button

Upload Map Data

Image

Coordinates

3. Find the Map Image file to upload on the PC using the Browse function
4. Find the file that holds the GPS co-ordinates of 3 corners of the image. If this file does not exist then click the Set Coordinates button and enter the GPS coordinates of the image as specified in the pop up entry box below. The GPS must be converted from degrees, minutes and seconds to just be entered in degrees.

Coordinates

	Latitude	Longitude
Top Left	50.877992	-1.269984
Top Right	50.877987	-1.237448
Bottom Left	50.863997	-1.269967

Up to 4 maps can be loaded by selecting the appropriate radio button.

If a GPS receiver is connected to a node then the GPS data can be used by

1. Click on the NETNode icon on the map to select it.
2. Click to activate the 'Use GPS' tick box on the Maps tab after selecting the Node
3. If the Node is located within the Mapped image then it will be automatically positioned on the map.

Nodes with GPS will also display their latitude, longitude, height, speed, course and satellite fix statistics.

Nodes without GPS can be positioned on the map manually. Click on the NETNode to be positioned and drag it to the required position.

Note: It is the user's responsibility to ensure that they have permission to use any mapping data loaded onto the unit.

Show Details Tick Box

Ticking this box will display IP Packet statistics information for the selected NETNode.

Show Names Tick Box

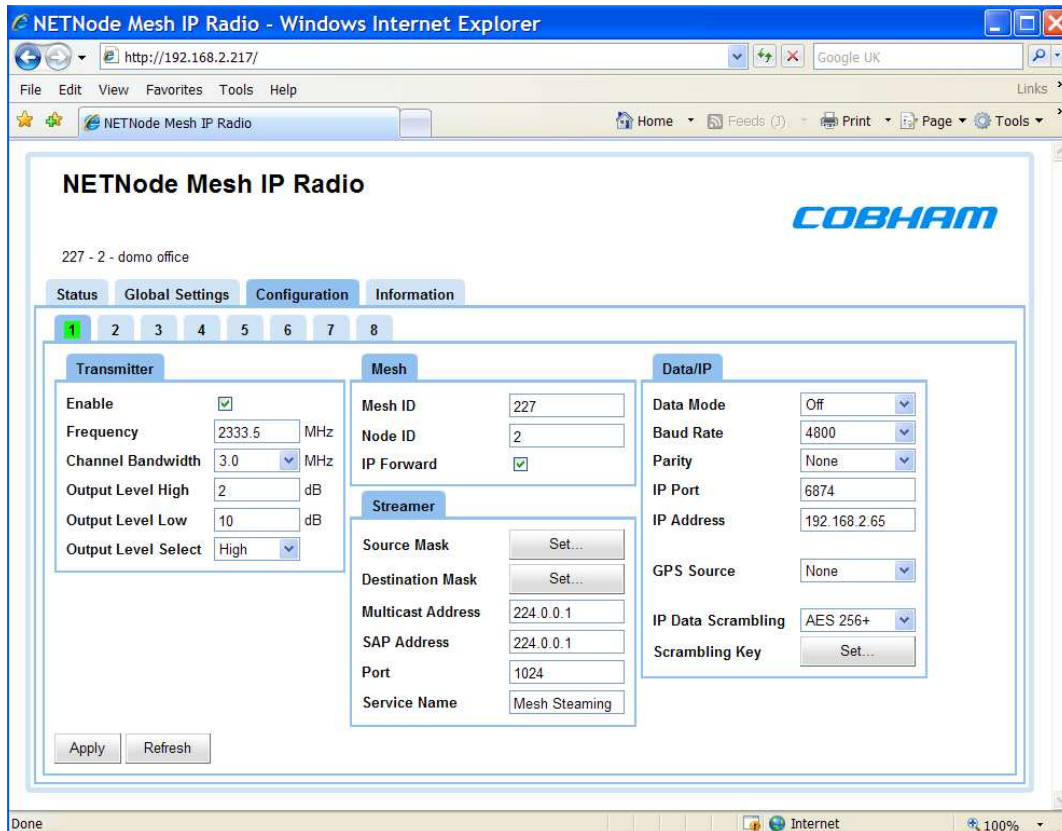
Ticking this box displays the unit names on the MESH map image.

Reset Locations button

This resets the location of all the NETNode unit back onto the map, switching off the GPS tracking function. This can be useful if a user loses nodes off the edge of the map image.

Configuration Page

This Tab is used to modify any of the radio settings.



Scrambling key is ONLY activated if it applied after it is set. The user must click the apply button after setting the scrambling key type and entering the key.

Transmitter

The transmitter section allows a user to alter the frequency of a NETNode, set the transmission bandwidth and adjust the output power level of the NETNode.

The Channel bandwidth can be altered between 2.5, 3 and 3.5MHz

2.5MHz Bandwidth gives approximately 2.5Mbps of Network capacity

3MHz Bandwidth gives approximately 3Mbps of Network capacity

3.5MHz Bandwidth gives approximately 3.5Mbps of Network capacity

The Output Level High and the Output Level Low settings are dB back-off figures from the maximum rated power (1W). The user can adjust both settings between 0 and 30dB and select whether the high or low power is active.

Note: Any changes are ONLY implemented following an APPLY command

Mesh

The Mesh functions allow the user to specify the NETNode Mesh ID number, Node number and whether the Node is allowed to forward IP data.

The Mesh ID number MUST be set identically between all nodes in a Mesh. If a NETNode detects a Mesh network on the correct frequency but with a differing Mesh ID from its own then it will NOT join the network.

Each NETNode in Mesh Network must have its own distinct Node ID – this can vary from 0 to 7.

Forwarding of IP packets from one Node in a network through another node to an end node can be allowed or disabled using the IP forwarding Check box.

Streamer

Enables or disables the onward streaming of the received Video / Audio data via the Ethernet.

Source Mask

This pop-up box enables the streaming of Video that originates from a network connected to either one of the two NETNode Ethernet ports or from the internal encoder (if it is fitted). Enabling one of the two Ethernet ports allows a stream on an external network to pass into the Mesh network or from the internal MPEG encoder (if fitted in the NETNode as option NETNode-AVI-UP).

Destination Mask

This pop up box allows the user to specify precisely which nodes need to receive the stream. Streaming to all nodes may be an inefficient use of MESH IP capacity and so the user may wish to restrict the multicast to specific nodes.

Multicast Address

This control allows the user to change the multicast address used by the unit. The default value is 239.16.33.254.

SAP Address

This control allows the user to change the value SAP/ SDP multicast address used by the unit. The default value is 224.2.127.254 and the port used is 9875. These are standard multicast values for such parameters, and it is recommended they are not changed unless specifically required due to routing restrictions.

Stream Port Number

This control allows the user to change the multicast port used by the unit. The default value is 10000.

Service Name

Textual information naming the multicast stream as delivered in the SAP/SDP packets from the unit. Default is "*MPEG Stream*"

Data/IP

The NETNode can send and receive data through either its RS232 serial port or its RS485 serial port. The switch between the RS232 port and the RS485 port is found under the 'Global Settings' tab.

Data Mode

The data port can be configured to be either off, unidirectional/bi-directional UDP or bi-directional TCP.

Baud rate and Parity

These settings allow the user to configure the Baud rate and parity settings for the data connection. The allowed Baud rates are 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200. The data is assumed to be 8 bits and the parity can be none, odd or even.

IP Port and IP Address

These set an IP address and Port to and from which the data will transferred.

The user can connect to the data port via telnet by setting the mode to TCP and the port number to 23.

The user can connect two data ports on different units together via setting UDP mode and using the matching port numbers.

GPS Source

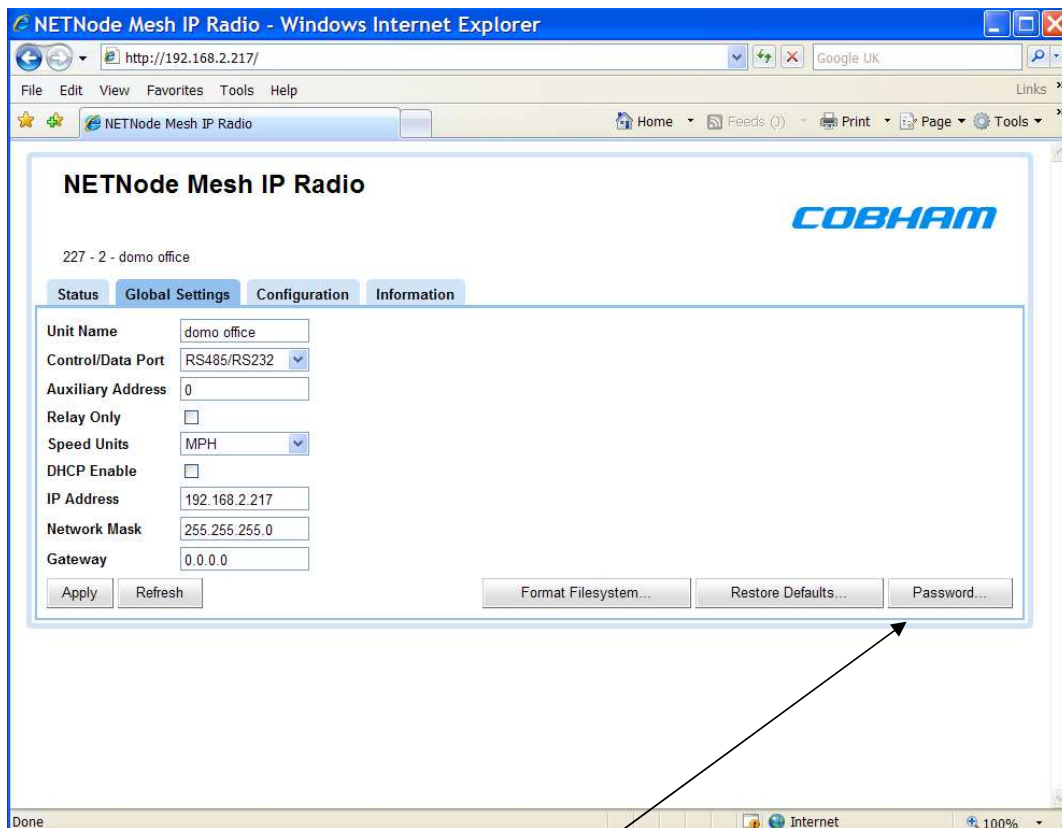
A user can connect a GPS receiver data port to either the main serial port or via the optional Encoder serial data port.

IP Data Scrambling

Can be AES128 or AES256 – this encrypts ALL user data exchanged over the network.

The AES128+ and AES256+ settings ensure that the network will only process encrypted data. Any data sent in the clear by any nodes will not be presented or accepted by a NETNode if the AES+ is set on the unit.

Global Settings



Allows the user to changes the web password

Unit Name

This field allows the user to attach a text string to a NETNode to add identification on the Map.

Control Port / Data Port

The user can assign the control port to the RS232 serial port and the Data port to the RS485 serial port or vice versa.

Auxiliary Address

This should be set to '1' if an optional encoder is present. It is not setting that the user need modify in normal operation.

Relay Only

If this box is ticked then the Node will forward or receive any data from the mesh network. It is however still possible to control the unit locally.

Speed Units

A drop down list that allows the user to select the unit (km, mph etc) used to report the speed measured by the GPS.

DHCP Enable

If ticked then the NETNode will try to acquire its IP address from a DHCP server on the network – this DHCP server can be located through another NETNode over the radio interface.

IP Address

If the NETNode is not automatically acquiring its IP address via a DHCP server then a fixed IP address needs to be assigned to the unit. This address is typically obtained from a network administrator to avoid a clash of IP addresses on any network. The unit is expecting an IPv4 address.

Network Mask

The network mask allows a network administrator to break a network into smaller more efficient subnets to prevent excessive numbers of IP packets being routed through the network. This is normally defined by the network administrator

Gateway

A default gateway is used by a host when an IP packet's destination address belongs to someplace outside the local subnet. The default gateway address is usually an interface belonging to the LAN's border router.



Streaming Video over IP

General Info

This section is relevant only to customers that have the **NETNode-AVI-UP** option fitted into their NETNode unit.

Streamer

The received video data is transmitted over the Ethernet network by means of "multicasting" i.e. continuous real-time streaming of packets accessible to any PC connected to the network.

It is therefore possible for more than once connected PC to view the streamed data simultaneously.

Two types of multicast IP packets are streamed.

- Packets carrying video, audio and data as received by the unit;
- Packets known as Session Announcement Protocol and Sessions Description Protocol data (SAP and SDP), which contain information regarding the nature and location of the stream itself.

Configuration of the Streamer

The web-server control allows configuration of the streaming function.

Source Mask

This pop-up box enables the streaming of Video from either one of the two external Ethernet ports or from the internal encoder (if it is fitted). Enabling one of the two Ethernet ports allows a stream on an external network to pass into the Mesh network or from the internal MPEG encoder (if fitted in the NETNode as option NETNode-AVI-UP).

Destination Mask

This pop up box allows the user to specify precisely which nodes need to receive the stream. Streaming to all nodes may be an inefficient use of MESH IP capacity and so the user may wish to restrict the multicast to specific nodes.

Please note after hitting the OK box on the source or destination mask, the main Apply Bottom must be pressed to action the command.

Multicast Address

This control allows the user to change the multicast address used by the unit. The default value is 239.16.33.254.

SAP Address

This control allows the user to change the value SAP/ SDP multicast address used by the unit. The default value is 224.2.127.254 and the port used is 9875. These are standard multicast values for such parameters, and it is recommended they are not changed unless specifically required due to routing restrictions.

Stream Port Number

This control allows the user to change the multicast port used by the unit. The default value is 10000.

Service Name

Textual information naming the multicast stream as delivered in the SAP/SDP packets from the unit. Default is "*Mesh Streaming*"



Software Decoder

General Information

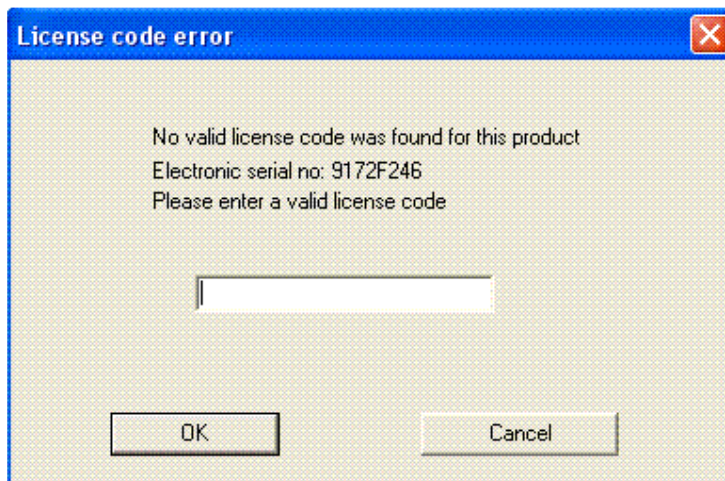
The **domo** software decoder application (part number **NETSWDR**) is delivered on CD. The product is installed by following the prompts offered by a comprehensive Install Shield.

The product is licensed, after installing the product from the Installation shield the user should double click on the application icon, which may appear as depicted below.



Note – later revisions of the software decoder may feature different icons or application names.

When the application is executed, if the PC is unlicensed then the following prompt box appears



Assuming the user has pre-paid for their Software decoder licence then the user then simply needs to email the Electronic Serial number to **domo** (sales@domo.co.uk) quoting the pre-paid token number. After receipt of this email **domo** will then provide a licence key. The licence key should be entered into the prompt box in the application window above which will licence the PC.

The license is tied to the target PC, and reinstallation of the product on a different machine will require the purchase of further licenses from **domo**.

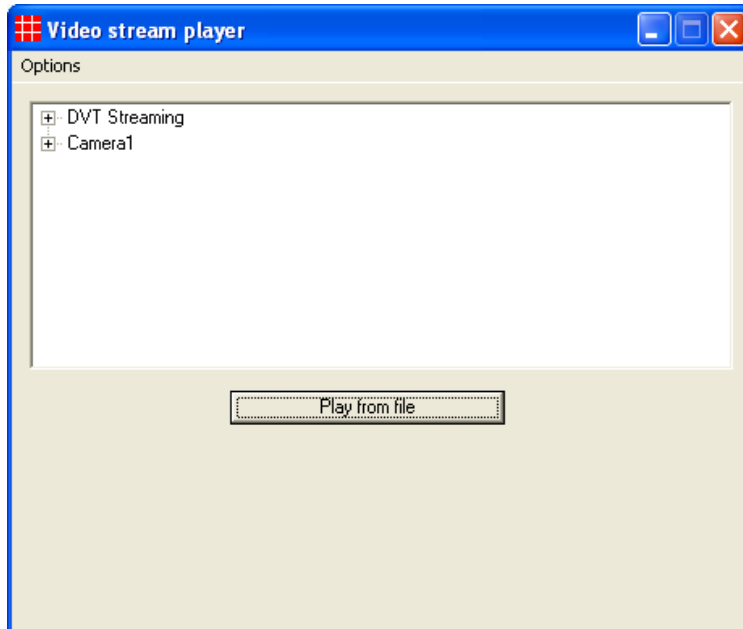
Note – if a user has not purchased a pre-paid licence then the user will have to contact **domo** sales to purchase a licence prior to receiving a licence code.

The **domo** software decoder can decode and present MPEG streams that are available from two sources.

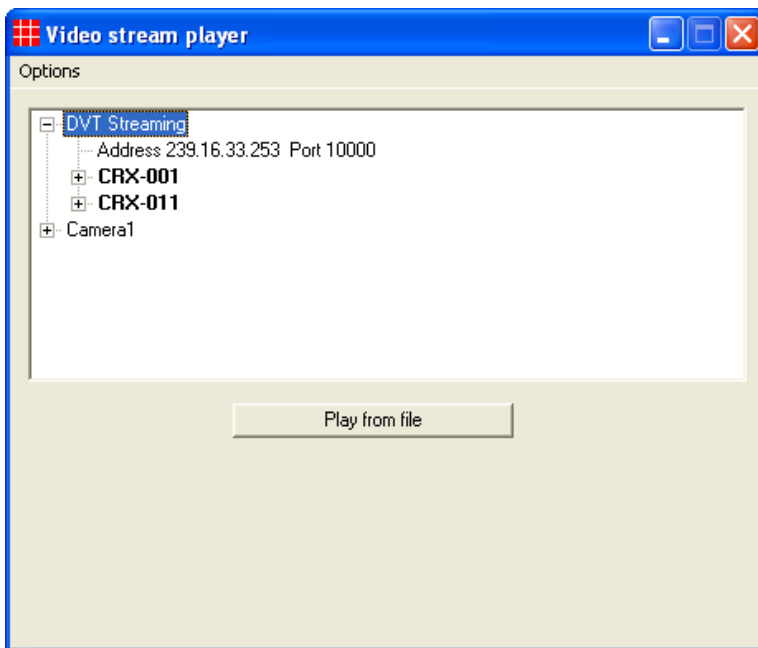
- Multicast streams being played out on the connected network by a NETSTREAM or NETCRXIPUP IP upgrade in the CRX.
- Files available locally on the target PC or network.

Decoding Multicast Streams

If the application is started on a PC, which is connected to a network shared by the NETSTREAM or CRX IP stream, then it will present a view of available streams that can be software decoded and viewed on the PC.

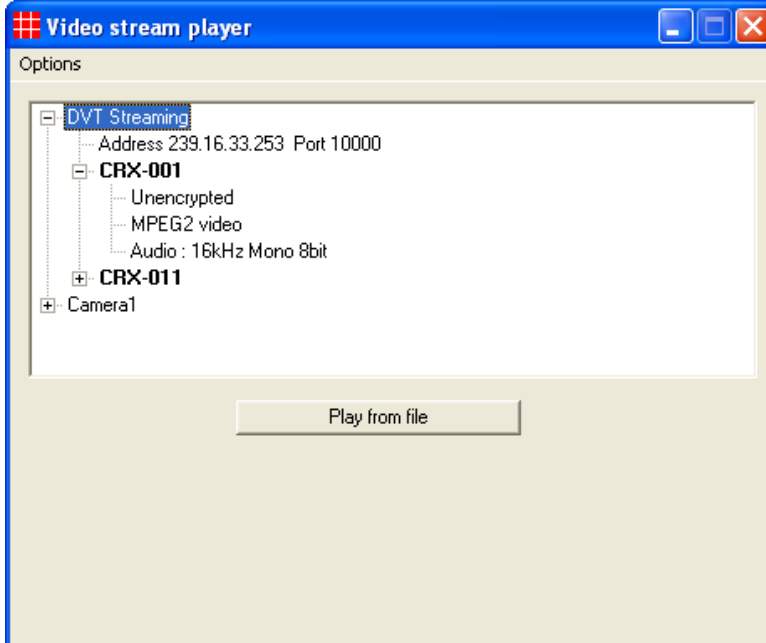


The name of the multicast stream is listed in the window, alongside an expandable crosshair. Clicking the crosshair presents the streams multicast details and a list of any services contained within a stream:



In the above example the stream "DVT Streaming" has a multicast address of 239.16.33.253 and is streaming to port number 10000. It contains two services, named "CRX-001" and "CRX-002".

It can be seen that there is an expandable crosshair alongside each of the service names. Clicking these provides more details about each service:

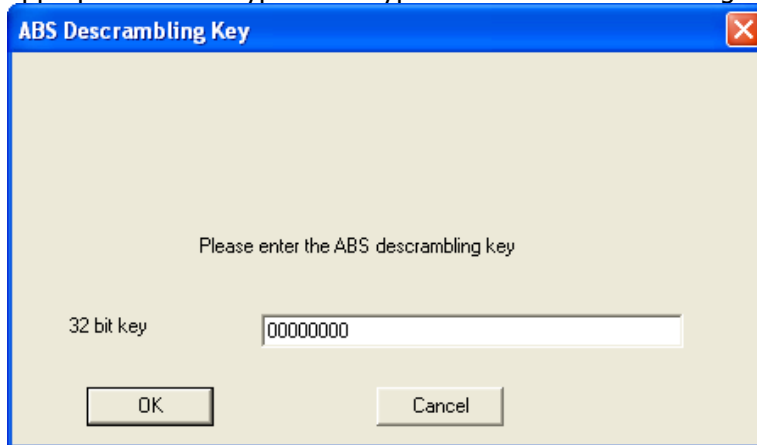


In this case we see that the service "CRX-001" is unencrypted, uses MPEG2 video encoding, and has single channel (mono) audio encoded with an 8-bit companding scheme with a sampling rate of 16kHz.

To start decoding a service the user should “double click” the appropriate service name. Service names are always highlighted in bold text in the main player window. If the service is unencrypted the main decoder window will be launched.

Encrypted Streams

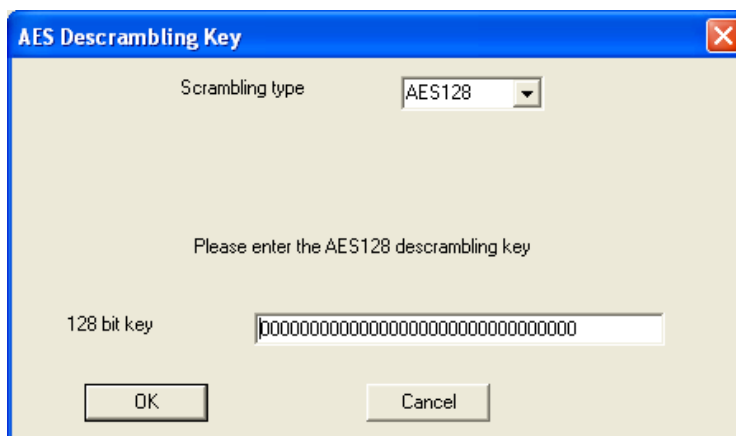
If the service selected is being encrypted by upstream hardware, then the user will be prompted for the reciprocal key. The video stream player can detect from information in the stream whether ABS or AES encryption is being used. It will present a window appropriate to the type of encryption. For ABS the following window will appear:



The screenshot shows a dialog box titled "ABS Descrambling Key" with a close button (X) in the top right corner. The background is a light beige color. The text "Please enter the ABS descrambling key" is centered. Below this, on the left, is the label "32 bit key". To the right of this label is a text input field containing the text "00000000". At the bottom of the dialog are two buttons: "OK" on the left and "Cancel" on the right.

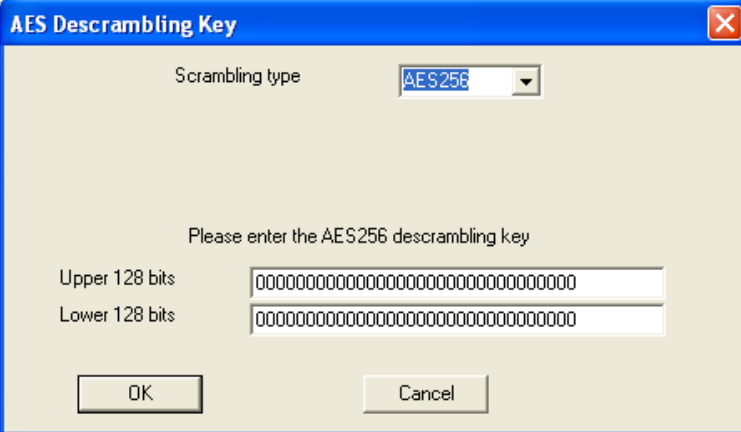
This requires the 32-bit ABS decryption key to be entered as 8 hexadecimal characters. This is not case sensitive.

Although the player is able to distinguish a service encrypted with AES, it cannot detect whether 128-bit or 256-bit AES encryption has been used. Therefore the following window will be presented to the user when AES encryption is detected:



The screenshot shows a dialog box titled "AES Descrambling Key" with a close button (X) in the top right corner. The background is a light beige color. At the top, there is a label "Scrambling type" followed by a drop-down menu showing "AES128". Below this, the text "Please enter the AES128 descrambling key" is centered. Further down, on the left, is the label "128 bit key". To the right of this label is a text input field containing 32 zeros. At the bottom of the dialog are two buttons: "OK" on the left and "Cancel" on the right.

By default this window is expecting a 128-bit (to be entered as 32 hexadecimal characters) decryption key. If the service is encrypted with AES256 encryption, the user should select this from the “Scrambling type” drop-down list in the window. The appearance of the window will then change to the following:



AES Descrambling Key

Scrambling type: AES256

Please enter the AES256 descrambling key

Upper 128 bits: 00000000000000000000000000000000

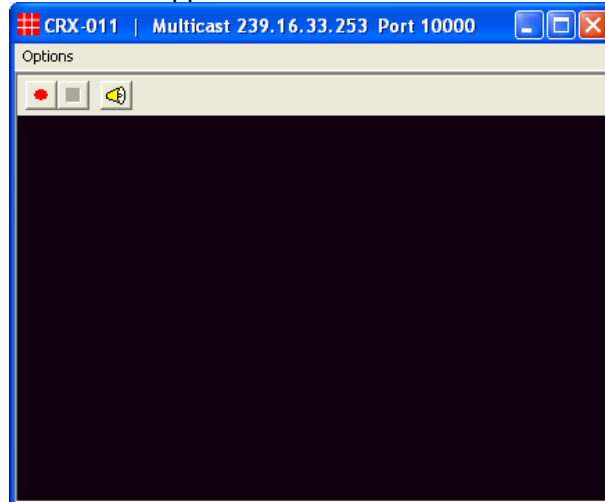
Lower 128 bits: 00000000000000000000000000000000

OK Cancel

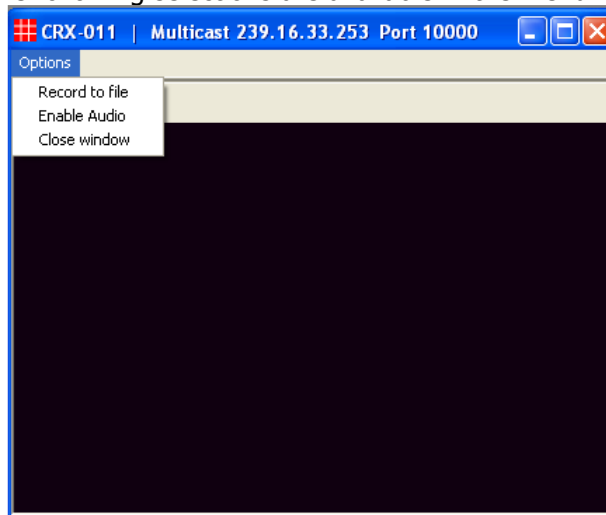
The user can now enter the AES256 key in the two fields provided. Once the key is entered, the main decoder window will be launched.

Main Decoder Window

The main decoder window will appear as follows:

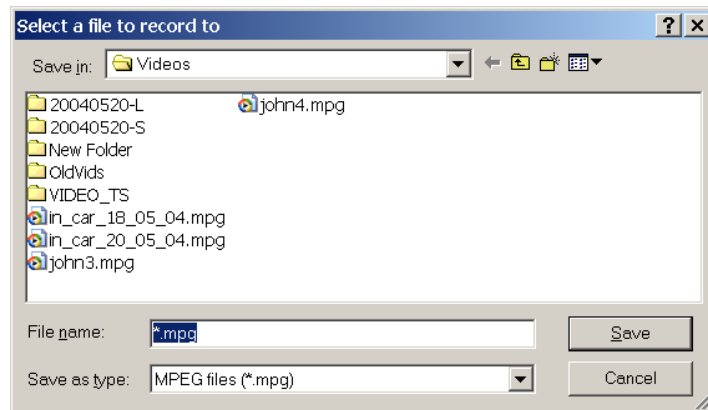


The title bar of the window presents the service name and the streams multicast details. Below this there is a menu-bar with an **Options** drop-down menu and a toolbar with some icons on it. Each of the icons corresponds to a selection in the **Options** menu. The following selections are available in the menu:



Record to file

This option gives the user the option of recording the file that is being decoded to disk. The user is prompted with a standard Windows "File Save" dialog box:



When recording is active, this menu option is changed to "Stop Recording" which can be used to stop writing to disk.

Two buttons on the toolbar can be used to control recording:



to start recording

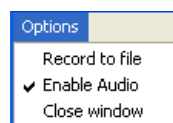


to stop recording



When recording is inactive, the stop recording button will appear greyed out and unselectable. The start recording button will appear in similar fashion when recording is active.

Enable audio

This option will only appear in the menu if the service has audio. When more than one service includes audio only one window can decode audio at any one time. When audio is enabled in a service, the enable audio option will appear with a tick beside it in the menu:



Selecting this option simply toggles whether audio is enabled or disabled. If another window was previously decoding audio it will be forced to disable its audio as the new window is now the audio decoding window.

When audio is enabled, the  button will appear on the toolbar. Clicking this button will disable audio. When audio is disabled this button will change its appearance and appear as , clicking which will enable audio.

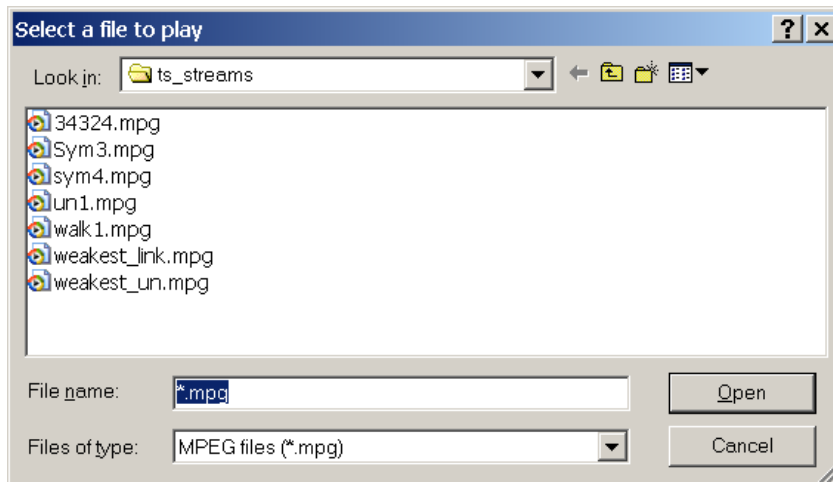
Close window

This closes the main decoder window.

Decoding Locally Stored Files

If the user wishes to play a file from local storage (regardless of whether multicast streams are available or not) then the "Play from File" button on the main application window should be pressed.

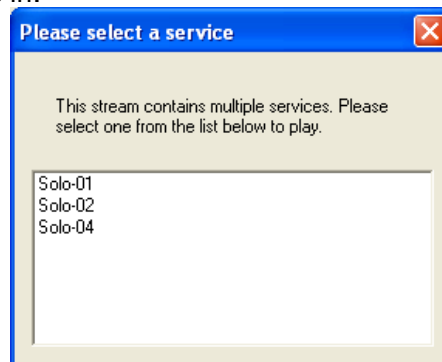
This opens a standard Windows "Open File" dialog box to make the selection.



Note - the default file extension is **.mpg*.

The application will scan through the selected file for any services available. If the stream contains only one service the application will select this automatically and operation will be as described in the preceding sections after a service is selected.

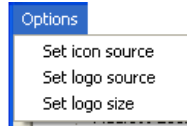
If there are multiple services in the file the application will present a pop-up window with a list of the services in:




The user should "double-click" the service they wish to decode. Thereafter, operation is as described in the preceding sections.

Miscellaneous application options

The main application window has a menu-bar with an **Options** drop-down menu. This presents the following selections:



These options relate to the main application icon, which normally appears as  and an optional logo. By default there is no logo presented. The user may select a bitmap to appear as a logo below the "Play from file" button on the main application window. Selecting either the "Set icon source" or "Set logo source" options will open a standard Windows file dialog box. For icon files, this is set to filter for files with a .ico file extension. These are standard Windows icon files. A 32 x 32 pixel icon is expected. For logo files, the dialog box is set to filter for bitmap files with a .bmp file extension. The size of the bitmap file is not important as the application will automatically make it fit to the available space. The logo size can be altered by selecting the "Set logo size" option in the menu.



Fault Finding

To be completed as field information is complied

LED Indicators

NETNode Unit



Top Led

This lights green if power is applied to the unit.

Bottom Led

This lights green if the unit is successfully connected to other NETNode units in a Mesh.

Connector Pin Outs**1.1 POWER – 2-way Female Amphenol Male Size 10**

Pin No	Function
A	12 V
B	Ground

CTRL / DATA 19-way Female Amphenol Size 14

Pin No	Function
A	RS485 Tx+
B	RS485 Tx-
C	GND
D	RS485 Rx+
E	RS485 Rx-
F	GND
G	Engineering Use Only
H	Engineering Use Only
J	GND
K	RS232 Control TX
L	RS232 Control RX
M	GND
N	Radio Controller Trainer +
P	Radio Controller Trainer -
R	GND
S	Secondary Ethernet OP
T	Secondary Ethernet ON
U	Secondary Ethernet IP
V	Secondary Ethernet IN

IP 4-way Female Amphenol Size 08

Pin No	Function
A	Ethernet OP
B	Ethernet ON
C	Ethernet IP
D	Ethernet IN

AV 10-way Female Amphenol Size 12

Pin No	Function
A	Audio Left
B	Ground Audio Left
C	Audio Right
D	Ground Audio Right
E	Ground
F	Composite / S-Video Luma
G	Video Ground
H	S-Video Chroma
J	Ground Chroma
K	Ground

Control Protocols

The control protocols for the NETNode are available upon request to dome Technical Support.

The unit can be controlled via RS232 command, RS485 command or Ethernet.

Default Configurations

This section tabulates the default configuration settings for the **domo** NETNode product.

Item	NETNode1W-217250
RF Output	OFF
Frequency	2405MHz
Mode	1.8Mbps
Power mode	Low
MESH ID	
Node ID	
GPS Source	None
Data Mode	OFF
Scrambling	OFF
AES Key	None
AVI-UP Option	
Video Input	PAL (if AVI-UUP fitted)
Audio	OFF
Horizontal Resolution	528

Default IP Address

192.168.2.101

Default Subnet Mask

255.255.255.0